PRICE 50 CENTS

RCA SENIOR VOLTOHMYST®

Type WV-97A

- Specifications
- Operation
- Applications
- Maintenance

RADIO CORPORATION of AMERICA

TEST AND MEASURING EQUIPMENT — HARRISON, N. J.

ITEMS

Supplied with WV-97A

1 Direct Probe and Cable.....Type WG-218
1 DC/Direct Probe.....Type WG-222
1 1.5-Volt Battery.....Type VS036
1 Ohms Probe and Cable
1 Ground Cable
1 Slip-On Alligator Clip
1 Insulator
2 RCA-6AL5 Tubes
1 RCA-12AU7 Tube
1 Instruction Booklet for WV-97A
1 Registration Card

ACCESSORIES

Available on Separate Order

For Measuring AC Voltages at Frequencies from 50 Kc to 250 Mc:
Crystal-Diode Probe.....Type WG-264

For Increasing DC Voltage Range to 50,000 Volts:
High-Voltage Probe.....Type WG-289
Multiplier Resistor.....Type WG-206

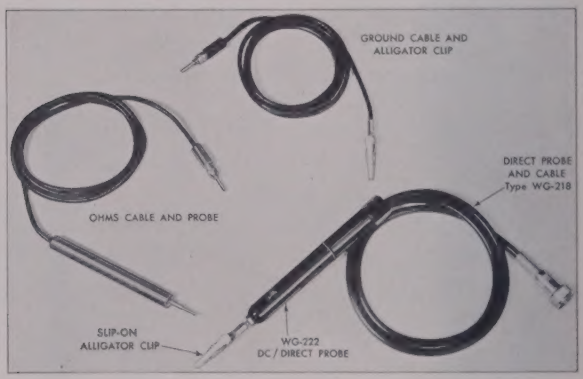

GROUND CABLE AND ALLIGATOR CLIP
DIRECT PROBE AND CABLE Type WG-218
OHMS CABLE AND PROBE
SLIP-ON ALLIGATOR CLIP
WG-222 DC/DIRECT PROBE

Figure 1. Probes and cables supplied with WV-97A

Devices or arrangements shown or described herein may use patents of RCA or others. Information contained herein is furnished without responsibility by RCA for its use and without prejudice to RCA's patent rights.

Copyright 1953
Radio Corporation of America
TMK ® Marca Registrada

Instr. WV-97A (8) 11-55
Printed in U.S.A.

Senior VoltOhmyst

Type WV-97A

Contents

	Page
Safety precautions	4
Items supplied with WV-97A	2
Accessories available on separate order	4, 16
General description	5
Specifications	6
Functions of controls and terminals	8
Operation and applications	9
Special applications	14
Replacement parts list	22
Circuit description	24
Maintenance	25
Trouble shooting the WV-97A	29

Illustrations

Figure No.		Page
1	Probes and cables supplied with WV-97A	2
2	Details of WV-97A scales	10
3	Circuit for resistance measurements above 1000 megohms	11
4	Typical voltage waveforms	12
5	Typical television waveforms	13
6	Pulse response capability of WV-97A	14
7	Graph for conversion of rms voltage to dbm values	16
8	Accessories available for use with WV-97A	17
9	Schematic diagram for all instruments except those with code no. 350	18
10	Schematic diagram for instruments with code no. 350	20
11	Locations of calibration controls	27
12	Locations of contacts on range switch, S1	30
13	Locations of contacts on function switch, S2	31
14	Exploded view of WG-222 DC/Direct Probe	32
15	Exploded view of WG-217 DC Probe	32

Safety Precautions

The metal case of this instrument is connected to the ground of the internal circuit. For proper operation, the ground terminal of the instrument should always be connected to the ground of the equipment under test. The WG-218 Direct Probe and Cable has a shield throughout its entire length which is connected to the instrument ground and case. Always handle the WG-218 by the insulated probe housing.

An important point to remember is that there is always danger inherent in testing electrical equipment which operates at hazardous voltages. Therefore, the operator should thoroughly familiarize himself with the equipment under test before working on it, bearing in mind that high voltages may appear at unexpected points in defective equipment. Additional precautions which experience in the industry has shown to be important are listed below.

1. It is good practice to remove power before connecting test leads to high-voltage points. If this is impractical, be *especially careful* to avoid accidental contact with equipment racks and other objects which can provide a ground. Working with one hand in your pocket and standing on a properly insulated floor lessens the danger of shock.

2. Filter capacitors may store a charge large enough to be hazardous. Therefore, discharge filter capacitors before attaching test leads.

3. Remember that leads with broken insulation provide the additional hazard of high voltages appearing at exposed points along the leads. Check test leads for frayed or broken insulation before working with them.

4. To lessen the danger of accidental shock, disconnect test leads immediately after test is completed.

5. Remember that the risk of severe shock is only one of the possible hazards. Even a minor shock can place the operator in hazard of more serious risks such as a bad fall or contact with a source of higher voltage.

6. The experienced operator continuously guards against injury and does not work on hazardous circuits unless another person is available to assist in case of accident.

General Description

The WV-97A Senior VoltOhmyst* is an all-electronic voltmeter designed to measure directly the peak-to-peak values of complex waveforms and the rms values of sine waves on separate scales. The instrument also reads dc voltage and resistance, employing vacuum tubes on all functions to insure good sensitivity and stability. For dc-voltage measurements, an input resistance of 11 megohms minimizes loading of the circuit under test. When used to measure ac voltages, the WV-97A has a maximum rated input of 4200 peak-to-peak volts and 1500 rms volts. The instrument will also measure dc voltages up to 1500 volts and resistance up to 1000 megohms.

Calibration of the Senior VoltOhmyst in peak-to-peak voltage values as well as rms voltage values is a desirable feature for applications such as television, radar, and other pulsed electronic systems where complex waveforms are encountered. As the meter reading is proportional to the full peak-to-peak value of the waveform, a better indication of the true value of the voltage is given than is possible with voltmeters which respond only to the positive or negative peak of the waveshape. (See AC Voltage Measurements," page 12.)

The WV-97A is frequency compensated for ac-voltage ranges up to and including the 500-volt range (500 rms volts or 1400 peak-to-peak volts) and can be used at frequencies up to approximately 3 megacycles, depending upon the impedance of the source voltage. The extended frequency range of the Senior VoltOhmyst, coupled with its high sensitivity, make it a convenient and reliable device for use in rf applications. When the auxiliary WG-264 Crystal-Diode Probe is used, the useable frequency range is extended to 250 megacycles. The WV-97A has an over-all accuracy of $\pm 5\%$ of full scale on ac-voltage measurements.

An input resistance of 11 megohms on all dc-voltage ranges allows the WV-97A to be used in circuits where instruments with a lower impedance would result in loading of the circuit under test and a resultant error in reading the operating voltage. The 11-megohm input resistance also has the advantage of not being so high as to impair the stability of the instrument. The over-all accuracy of the Senior VoltOhmyst on dc-voltage measurements is $\pm 3\%$ of full scale.

When used to measure resistance, the WV-97A will read from 0.2 ohm to 1000 megohms in seven ranges. Convenient midscale values are set at 10, 100, 1000, 10,000 and 100,000 ohms and at 1 and 10 megohms.

Additional features of the WV-97A include provision for zero-centering of the meter pointer, a useful adjustment for checking FM discriminator alignment and the polarity and condition of bias cells; one separate scale for low-voltage ac measurements; circuit design which permits measurements of the ac component of a dc voltage or the dc component of an ac signal; and large, easily read meter scales stamped in black and red for direct reading of rms, peak-to-peak, and dc voltage values. Circuit design also prevents any dc-loading effect when the WV-97A is used to measure ac voltages.

---

*Trade-Mark "VoltOhmyst" Reg. U. S. Pat. Off.

The light-weight probes and cables supplied with the WV-97A have been designed to match the mechanical and electrical characteristics of the instrument. The WG-218 Direct Probe and Cable is designed to accommodate either the WG-222 DC/Direct Probe or the WG-264 Crystal-Diode Probe, which slip onto the front end of the WG-218 to form a sturdy, insulated probe without the addition of an extra cable. When the WG-222 is used, both ac and dc voltage measurements can be made. It is only necessary to set the probe switch to the desired setting.

For measurement of ac voltages up to 250 megacycles, the auxiliary WG-264 Crystal-Diode Probe may be used. DC voltages up to 50,000 volts may be measured with the Senior VoltOhmyst when the auxiliary WG-289 High-Voltage Probe is connected to the "VOLTS AC DC" terminal.

The RCA WV-97A Senior VoltOhmyst is a versatile instrument, designed to give quality performance. A reliable measuring device, it enables the user to make a wide variety of accurate electrical measurements in all kinds of electrical equipment.

Specifications

Electrical

NOTE: Performance figures are for line voltage of 117 volts, 60 cps.

DC Voltmeter:

Ranges ..... 0 to 1.5, 5, 15, 50, 150, 500, 1500 volts
Input Resistance (With switch on WG-222 set to "DC"):
All Ranges ..... 11 Megohms
Sensitivity on 1.5-V Range ..... 7.3 megohms/volt
Over-all Accuracy ..... ±3% of full scale

AC Voltmeter: (For all instruments with code number 350.)

Ranges:

RMS Values of Sine Waves ..... 0 to 1.5 volts on separate LO-AC scale; 0 to 5, 15, 50, 150, 500, 1200 volts▲

Peak-to-Peak Values of Sine Waves & Complex Waves ..... 0 to 4 volts on separate LO-AC scale; 0 to 14, 42, 140, 420, 1400, 3400 volts▲

Over-all Accuracy ..... ±5% of full scale

Input Resistance and Capacitance
(With switch on WG-222 set to "Direct"):
1.5, 5, 50, 150-V Ranges ..... 0.83 meg. shunted by 70 μμf
500-V Range ..... 1.3 meg. shunted by 60 μμf
1200-V Range ..... 1.5 meg. shunted by 60 μμf

Frequency Response:

NOTE: The response data below are for the 1.5, 5, 15, 50, 150, and 500 volt ranges. The 1500-volt range is flat at power-line frequencies.

(With switch on WG-222 set to "Direct"):
For source impedance of approximately 100 ohms or lower ..... 30 cps to 3 Mc□
For source impedance of approximately 1000 ohms or lower ..... 30 cps to 500 Kc△
For source impedance of approximately 5000 ohms or lower ..... 30 cps to 270 Kc○
For source impedance of approximately 10,000 ohms or lower ..... 30 cps to 80 Kc◆

With Crystal Probe WG-264•.....within ±10% from 50 Kc to 250 Mc
Pulse-Response Capability.....See Figure 6

AC Voltmeter: (For all instruments except those with code number 350.)

Ranges:
RMS Values of Sine Waves.....{0 to 1.5 volts on separate LO-AC scale; 0 to 5, 15, 50, 150, 500, 1500 volts}
Peak-to-Peak Values of Sine Waves & Complex Waves.....{0 to 4 volts on separate LO-AC scale; 0 to 14, 42, 140, 420, 1400, 4200 volts}
Over-all Accuracy.....±5% of full scale

Input Resistance and Capacitance
(With switch on WG-222 set to "Direct"):
1.5, 5, 50, 150-V Ranges.....0.83 meg. shunted by 70 μμf
500-V Range.....1.3 meg. shunted by 60 μμf
1200-V Range.....1.5 meg. shunted by 60 μμf

Frequency Response:
NOTE: The response data below are for the 1.5, 5, 15, 50, 150, and 500 volt ranges. The 1500-volt range is flat at power-line frequencies.
(With switch on WG-222 set to "Direct"):
For source impedance of approximately 100 ohms or lower.....30 cps to 3 Mc□
For source impedance of approximately 1000 ohms or lower.....30 cps to 500 Kc△
For source impedance of approximately 5000 ohms or lower.....30 cps to 270 Kc○
For source impedance of approximately 10,000 ohms or lower.....30 cps to 80 Kc♦
With Crystal Probe WG-264•.....within ±10% from 50 Kc to 250 Mc
Pulse-Response Capability.....See Figure 6

Ohmmeter:
Ranges, Seven.....0 to 1000 megohms

Meter Movement:
DC Current for Full-Scale Deflection.....200μa

Tube Complement:.....2 RCA-6AL5, 1 RCA-12AU7

Power Supply:
Voltage Rating.....105-125 volts
Frequency Rating.....50/60 cps
Power Consumption (Approx.).....6 watts
Battery (1.5-volt cell).....1 RCA-VS036

Maximum Input Voltages: (For instruments with code number 350.)
DC voltages with no ac voltage present:.....1500 volts
AC Voltages with no dc voltage present:
RMS for Sine Waves.....1200 volts
Peak-to-Peak for Sine Waves.....3400 volts
Peak-to-Peak for Complex Waves.....1400 volts
Combined AC and DC Voltages:
Sum of DC Voltage and AC Peak Voltage:
AC Component Measurements.....1400 volts
DC Component Measurements.....1500 volts

▲CAUTION: See Maximum Input Voltages.
□Response is up about 10% at 3 Mc.
△Response is up about 10% at 500 Kc.
○Response is down about 10% at 270 Kc.
♦Response is down about 10% at 80 Kc.
•Available on separate order.

Maximum Input Voltages: (For all instruments except those with code number 350.)

DC Voltages with no ac voltage present:	1500 volts
AC Voltages with no dc voltage present:	
RMS for Sine Waves	1500 volts
Peak-to-Peak for Sine Waves	4200 volts
Peak-to-Peak for Complex Waves	2000 volts
Combined AC and DC Voltages:	
Sum of DC Voltage and AC Peak Voltage	2000 volts

Mechanical

Over-all Dimensions:

Height	7⅞ inches
Width	5¾ inches
Depth	4½ inches
Weight	5½ pounds
Finish	blue-gray hameroid case, satin aluminum panel

Functions of Controls and Terminals

Function selector—Has two functions. Turns power off when set to "OFF" position and selects operating function of instrument when set to other positions.

Range selector—Permits choice of range for the desired voltage or resistance measurements.

ZERO ADJ control—Used to position the meter pointer at either the left-hand "O" position or, when function selector is set to "VOLTS", to the zero-center "O" position.

OHMS ADJ control—Used to position the meter pointer at the extreme right line on the "R" scale when the function selector is in "OHMS" position.

VOLTS AC DC terminal—Direct Probe and Cable and its attaching DC/-Direct Probe are connected here for all ac and dc voltage measurements. Ground cable must be plugged into GND terminal and connected to circuit under test.

OHMS terminal—Ohms cable plugs in here for all values of resistance measurements. Ground cable must be inserted in GND terminal and connected to circuit under test.

GND terminal—is connected directly to chassis of the WV-97A and serves as a common return point for all resistance and ac and dc voltage measurements. Ground cable is inserted here and connected to circuit under test.

Operation and Applications

Either the WG-222 DC/Direct Probe or the WG-217 DC Probe may be used with the WG-218 Direct Probe and Cable. When changing from dc-voltage to ac-voltage measurements with the DC/Direct Probe, it is only necessary to change the position of the sliding switch. For instruments equipped with the DC Probe, it should be understood that reference in the text to the "DC" position of the switch means that the DC Probe is used and in cases where the use of the "Direct" position is mentioned, the Direct Probe alone should be used.

Preliminary Adjustments:

To prepare the WV-97A for use, make the following connections and adjustments:

1. Connect the Direct Probe and Cable to "VOLTS AC DC" terminal, the Ground Cable to the "GND" terminal, and the Ohms Cable to the "OHMS" terminal. Slip the DC/Direct Probe onto the front end of the Direct Probe.

2. Plug the power cord into an ac outlet supplying 105-125 volts at 50/60 cycles, and adjust the controls as follows:

a. Turn the function selector to "+VOLTS" position and allow several minutes for the instrument to warm up.

b. Adjust the ZERO ADJ control to position the meter pointer at the left-hand "0"

NOTE: When making this adjustment, notice whether the position of the meter pointer changes when the function selector is switched to "—VOLTS". If the pointer position changes, readjust the mechanical zero control as described under "Maintenance".

c. Turn the function selector to the "OHMS" position. The pointer should deflect to approximately full scale.

d. Rotate the OHMS ADJ control to position the pointer at the last line on the "R" (ohms) scale.

e. Turn the function selector to the "AC VOLTS" position. If the meter pointer does not indicate zero volts when the function selector is set on "1.5 V", see "AC Calibration" and "Electrical Balance Check" in the Maintenance section. The instrument is now ready for use.

DC-Voltage Measurements:

CAUTION: Maximum input voltages must not be exceeded. See "Specifications," page 6.

The switch on the WG-222 DC/Direct Probe should be set to "DC" for all dc-voltage measurements.

The WV-97A has seven dc-voltage ranges: 0 to 1.5, 5, 15, 50, 150, 500, and 1500 volts. Although the meter is protected against burn-out under ordinary overloads, it is good practice to make a trial measurement at a range setting higher than the voltage expected. Continued or repeated overloads may impair the accuracy of the movement. To measure dc voltages, proceed as follows:

1. Set the function selector to "+VOLTS" or to "—VOLTS", as required.
2. Connect the clip of the Ground Cable to ground.

CAUTION: See first paragraph of "Safety Precautions," page 4.

3. Set the range selector to a range position higher than the voltage to be measured.

4. Touch or connect the DC/Direct Probe to the high side of the source voltage.

5. Reset range selector to a position which gives a reading nearest to full scale.

6. Read the dc voltage from the scale corresponding to the range selector setting.

Zero-Center Indication:

Zero-center indication is frequently useful because it allows observation of either positive or negative dc-voltage excursions without the necessity of resetting the function selector.

1. Set the function selector to "+VOLTS".

2. Rotate the ZERO ADJ control to position the pointer at the center "—0+".

3. Set the range selector to a position at least twice the voltage to be measured.

4. After a test reading has been made, the range control may be set to the lowest position which allows the pointer to remain on the scale.

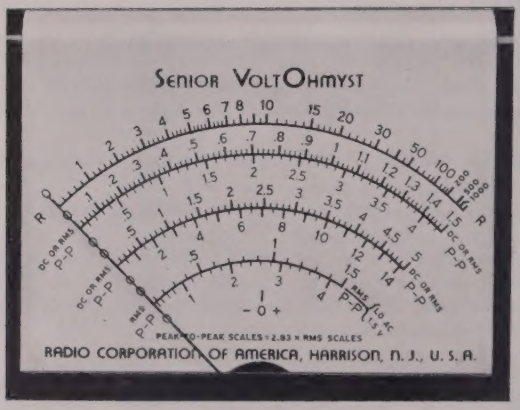


Figure 2. Details of WV-97A scales

Resistance Measurements:

The Ohms Cable is used in making all resistance measurements. Before resistance measurements are made, the power should be removed from the equipment under test so that no voltages are present.

1. Set the function selector to the "OHMS" position.

2. Set the range selector to the "R x 10" position.

3. Short the Ohms Probe to the Ground Cable and adjust the ZERO ADJ control to position the pointer at the left-hand "0" if necessary.

4. Separate the Ohms Probe from the Ground Cable. The meter pointer should deflect to full scale. If the meter pointer does not deflect to exactly full scale, use the OHMS ADJ control to obtain full deflection.

5. Connect the clip of the Ground Cable to one terminal of the resistance to be measured.

6. Touch or connect the Ohms Probe to the other terminal of the resistance to be measured.

7. Reset the range control to give a convenient deflection on the "R" (ohms) scale.

8. Multiply the reading on the "R" scale by the factor indicated by the range control setting.

CAUTION: Low-current, low-resistance devices, such as thermocouples and meter movements, may be damaged unless a range higher than "R x 10" is used because the WV-97A applies up to 1.5 volts across the resistance under measurement when the range control is set at "R x 1" or "R x 10".

Measurement of Resistance Values Above 1000 Megohms:

The leakage resistance of small mica and paper capacitors is usually above 1000 megohms. The circuit shown in Figure 3 can be used to measure resistance values above 1000 megohms. An external dc-voltage source between 20 and 500 volts is utilized to obtain a measurable pointer deflection. Make circuit connections as shown in Figure 3 and proceed as follows:

1. Set function selector to "+VOLTS" and measure the voltage at point B.
2. Measure the voltage at point A.
3. Compute the unknown resistance from the following formula:

$$\text{Rx(megohms)} = \frac{11\ [(\text{Volts at "A"}) - (\text{Volts at "B"})]}{(\text{Volts at "B"})}$$

EXAMPLE: The value of an unknown resistance is to be determined with the circuit of Figure 3. An external voltage of 500 volts is applied. The WV-97A measures 2.5 volts at "B", and 500 volts at "A". Then,

$$\text{Rx} = \frac{11\ (500\text{-}2.5)}{2.5} = 2200 \text{ megohms (approx.)}$$

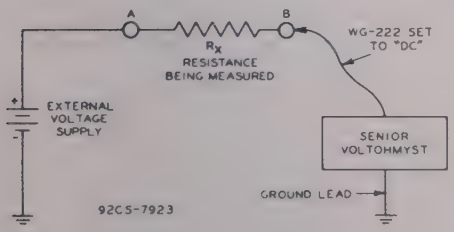


Figure 3. Circuit for resistance measurements above 1000 megohms

AC-Voltage Measurements:

CAUTION: Maximum input voltages must not be exceeded. The accuracy of meter indications is dependent upon the frequency of the ac voltage being measured, the waveshape, repetition rate, and the impedance of the voltage source. See "Specifications", page 6 and section below for additional information.

The switch on the WG-222 DC/Direct Probe should be set to "Direct" for all ac-voltage measurements.

1. Set the function selector to "AC VOLTS".
2. Adjust the ZERO ADJ control if necessary to position the meter pointer at the left-hand "0".
3. Set the range control to a position considerably higher than the voltage to be measured.
4. Connect the Ground Cable to the ground side of the voltage to be measured.
5. Touch or connect the DC/Direct Probe to the high side of the source voltage.
6. Reset the range control for a convenient deflection.
7. Read the ac voltage from the scale corresponding to the range control setting.

The meter scales of the WV-97A are calibrated in both rms and peak-to-peak voltages and are easily distinguished by their red and black colors. When values of sine waves are measured, for example, rms voltages are read from the black divisions and the corresponding values in peak-to-peak volts (equal to 2.83 times the rms voltage) are read from the red divisions. If the function selector is set at "15V" and a sine wave of 10 rms volts is applied to the instrument, the meter pointer will indicate 10 rms volts on the black scale and 28.3 peak-to-peak volts on the red scale. This time-saving feature makes the usual interpolation from one scale to another unnecessary.

Full-scale values for rms voltages are 1.5, 5, 15, 50, 150, 500, and 1500 volts. AC voltages from 0 to 1.5 rms volts (0 to 4 peak-to-peak volts) are read on the lower scale marked "LO-AC". Higher voltages, up to 1500 rms volts, are read on the two upper voltage scales.

Examples of typical voltage waveforms found in television circuits are shown in Figure 5. Examples of other types of basic waveforms which can be measured by the WV-97A are given in Figure 4.

The instrument has a maximum rated input for non-symmetrical waveforms of 2000 peak-to-peak volts. Sine waves and symmetrical complex waves up to 4200 peak-to-peak volts can be measured with somewhat reduced frequency response. (See Maximum Input Voltages and footnotes under "Specifications".)

Reliable ac voltmeter readings can be assured only if the characteristics of the voltmeter are compatible with the characteristics of the circuit under test. When the WV-97A is used to measure ac voltages, the "Specifications" on page 6

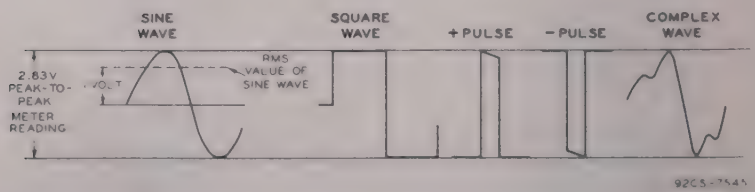


Figure 4. Typical voltage waveforms

should be considered. Information on input resistance and capacitance, frequency response, and pulse response is given.

It should be remembered that when the instrument is connected to any voltage source it may cause a loading effect on the circuit and result in a reduced voltage at the test point. When the instrument is not used in accordance with the conditions given under "Specifications", the normal operating voltages of the circuit may change, resulting in an erroneous reading of normal operating voltages.

When any voltmeter is used to measure ac voltages, certain precautions in the interpretation of readings are necessary because connection of the meter to the circuit may cause some disturbance. This is also true of the vacuum-tube voltmeter but its high input impedance minimizes such disturbances. The amount of circuit disturbance caused by the voltmeter is usually reflected in a decreased circuit voltage, the amount of decrease being dependent upon the characteristics of both the voltmeter and the test circuit.

For example, inaccurate readings of normal circuit conditions can be obtained from any one or a combination of the following conditions:

1. Where the impedance of the test circuit is higher than the impedance of the voltmeter. This condition will cause loading of the circuit to a degree dependent upon the ratio of the circuit impedance to the voltmeter impedance. As this ratio increases, the loading effect of the voltmeter is increased with a corresponding change in the normal operating conditions of the circuit.

2. If the capacitance of the circuit is low in relation to the input capacitance of the voltmeter.

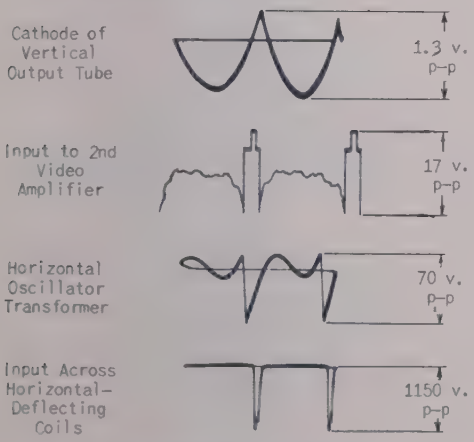


Figure 5. Typical television waveforms

3. If the frequency of the source voltage is higher than the upper frequency rating of the voltmeter.

4. If the voltage waveform in the test circuit consists of narrow pulses with a low repetition rate.

The last of these four conditions needs careful consideration in order to interpret correctly the peak-to-peak readings of the Senior VoltOhmyst. The values of the circuit capacitors and resistors used in the peak-to-peak rectifier circuit of the WV-97A have been chosen to give a discharge time which will provide a

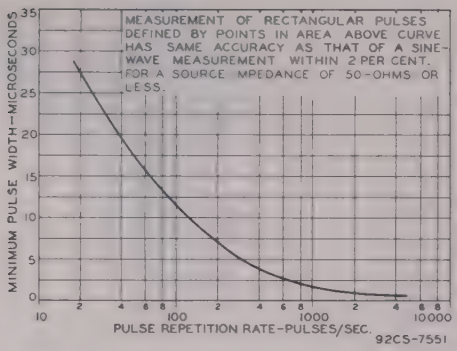


Figure 6. Pulse response capability of WV-97A

reliable peak-to-peak reading over its specified frequency range. If narrow pulses having a low repetition rate are applied to the rectifier circuit, the discharge rate may be so fast that the capacitors have dissipated an appreciable percentage of their peak charge by the time the next pulse is applied. As a result, both the rms and peak-to-peak voltage indications will be lower than the true value of the applied voltage.

Special Applications

In addition to maintenance and service applications of the WV-97A in ac, dc, af, and pulsed electronic and electro-mechanical equipment, the instrument may be used with versatility in numerous special applications. The special applications described below will help to illustrate the wide range of usefulness of the instrument.

Oscillator Grid-Bias Measurement. The negative dc voltage developed at the grid of an oscillator tube is proportional to the amplitude of oscillation. The impedance of these circuits is usually high and any test instrument inserted into the oscillator must be of sufficiently high impedance so as not to change appreciably the total value of the circuit impedance. The WV-97A is well suited to measurements of this nature. To measure grid bias, the instrument should be set up on the appropriate dc-voltage range and the switch on the DC Direct Probe set to "DC".

Comparative voltage readings should be taken on each band of a multi-band receiver and the main tuning capacitor should be rotated through each band while the bias is being measured.

AVC-Voltage Measurements. The WV-97A can be used to measure avc voltage at the diode-load resistor, along the avc bus, or at the grids of the controlled tubes.

Output Indication. The Senior VoltOhmyst is a useful instrument for measuring output in the alignment of radio and television receivers. In these applications, the switch on the DC Direct Probe is set to "DC" and the probe

connected to the load resistor of the second detector in AM and TV receivers while the circuit components are adjusted for optimum output. In an FM receiver, the probe is connected to the limiter load resistor. The zero-center feature of the WV-97A is particularly useful in alignment of FM discriminators.

Bias-Cell Voltage Measurements. These small voltages can be measured accurately by the WV-97A. The expanded voltage scales 0 to 1.5 and 0 to 5 volts provide easy-to-read indications of small voltages, an important feature where bias voltages are critical.

Detection of Gassy Tubes. Gassy tubes frequently may pass the check of an ordinary tube tester but cause improper functioning of equipment in which they are installed. The presence of gas in an output tube or avc-control tube, for example, can impair the function of the entire receiver. If a tube is gassy, measurement of the grid bias in an RC-coupled circuit will indicate an abnormal value of bias.

Insulation-Resistance Measurements. Current leakage through the dielectric of capacitors and insulation of coils, transformers, cables, and other components can be measured with the WV-97A in terms of resistance. Values of leakage resistance above 1000 megohms can be measured with the circuit shown in Figure 3.

When making resistance measurements, the Direct Probe of the WV-97A is always positive with respect to the Ground Cable. This arrangement facilitates the measurement of leakage resistance in components such as electrolytic capacitors where polarity must be observed.

DBM Measurements. The graph on page 16 can be used to determine dbm values corresponding to rms ac-voltage values across a 600-ohm resistive load. A dbm value is defined as the number of decibels above or below a reference level of 1 milliwatt in 600 ohms at 1000 cycles. Zero dbm, therefore, would indicate a power level of 1 milliwatt; 10 dbm, 10 milliwatts; and 20 dbm, 100 milliwatts.

The graph makes possible rapid conversion of rms voltages to corresponding dbm values. Associated power levels can be read along the top of the graph. If the rms voltage is measured across a resistive load other than 600 ohms, the correction factors given below must be added algebraically to the dbm values read

Resistive Load at 1000 cps	DBM*
600	0
500	+0.8
300	+3.0
250	+3.8
150	+6.0
50	+10.8
15	+16.0
8	+18.8
3.2	+22.7

*DBM is the increment to be added algebraically to the dbm value read from Figure 7, page 16.

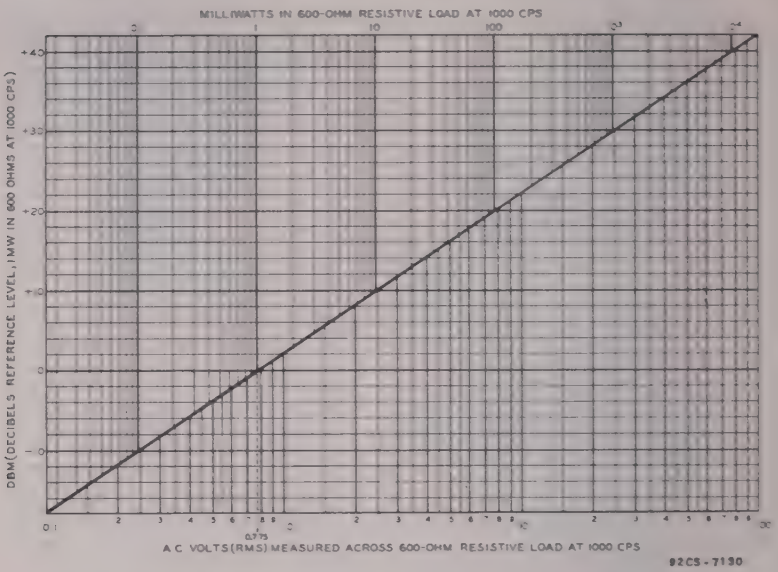


Figure 7. Graph for conversion of rms voltages to dbm values

from the graph in Figure 7. For resistive loads not given in the table, the following formula should be used for determining the correction factor:

$$\text{Correction Factor} = 10 \log \frac{600}{R}$$

where R is the load in ohms. If R is greater than 600 ohms, the correction factor is negative.

Because dbm are defined with respect to a 600-ohm load, power levels correspond to voltage values. DBM can be measured in terms of rms voltages across a 600-ohm resistive load. For example, 0.775 rms volt indicates 0 dbm and 7.75 rms volts indicate 20 dbm. While these measurements must be made with a sine waveform to avoid waveform error, any frequency can be used which is within the range of the WV-97A. The decibel and ear-response curves have their closest correlation at 1000 cycles.

Accessories

Available on Separate Order

When the WG-264 Crystal-Diode Probe is used with the Senior VoltOhmyst, the usable frequency range is extended to 250 megacycles. This probe consists of a germanium rectifier and an RC network in a polystyrene housing. The probe, which slips onto the front of the WG-218 Direct Probe and Cable, eliminates an extra cable.

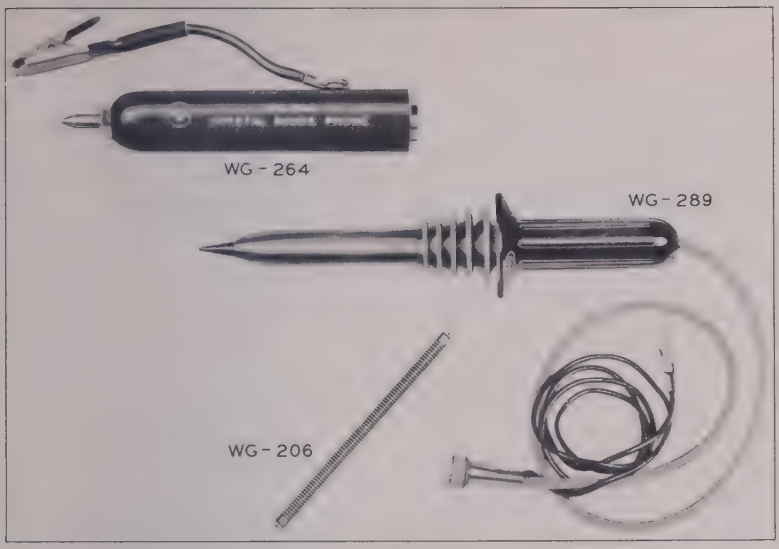


Figure 8. Accessories available for use with WV-97A

The WG-264 may be used in rf circuits of up to 20 rms volts in the presence of dc voltage as high as 250. The over-all frequency range of the probe is from 50 Kc to 250 Mc. All voltage readings are made on the dc scales in terms of rms volts for sine waves.

DC voltages as high as 50,000 volts can be measured directly by the WV-97A when the WG-289 High-Voltage Probe is used. The probe uses the WG-206 Multiplier Resistor, of 1090 megohms, to present an over-all voltmeter input resistance of 1100 megohms. With a multiplying factor of 100, the Senior VoltOhmyst provides six full-scale positions of 150, 500, 1500, 5000, 15,000, and 50,000 volts. The 150,000-volt scale should not be used. This extremely high input impedance is especially desirable when it is necessary to measure voltages found in phototube, television, and other high-impedance circuits which would not function properly if loaded down by a low-impedance voltmeter.

The WG-289 High-Voltage Probe offers distinct advantages in high-voltage circuits as well as low-voltage circuits characterized by high impedance or poor regulation.

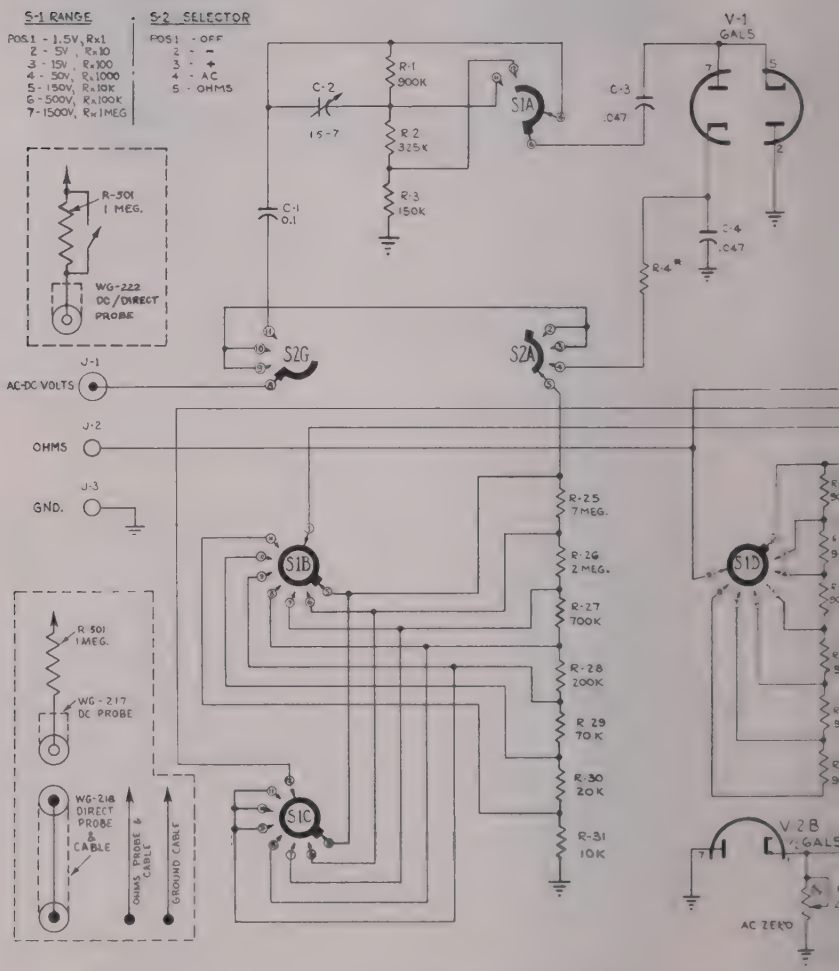
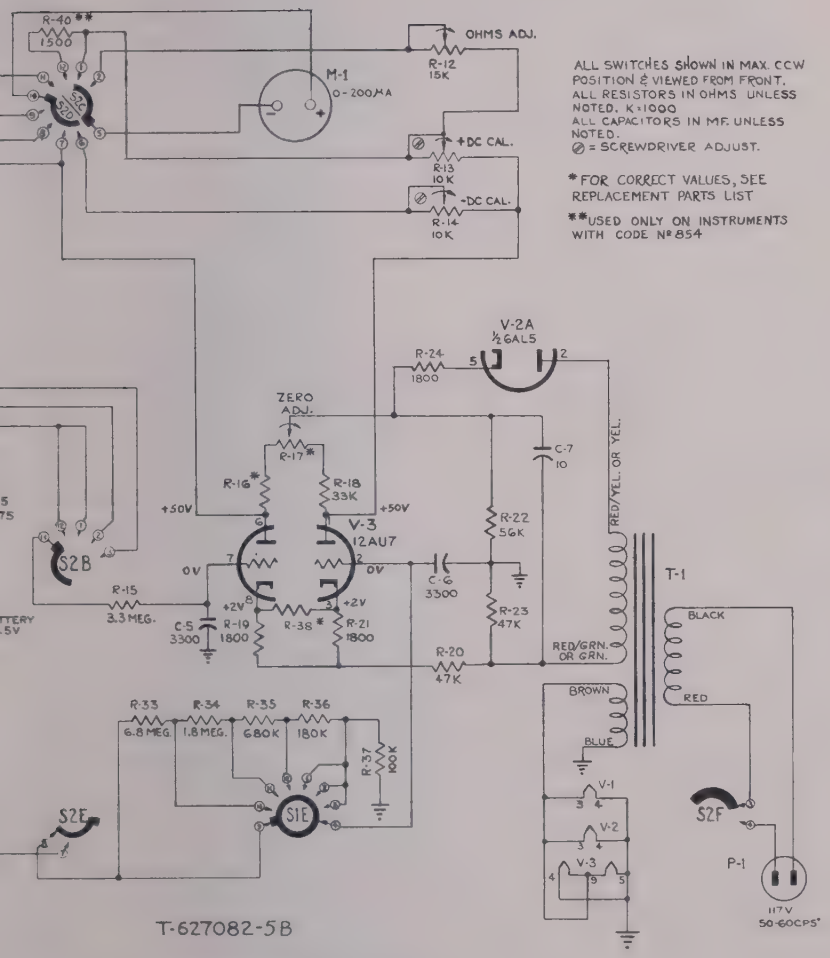


Figure 9. Schematic diagram for o



struments except those with code no. 350

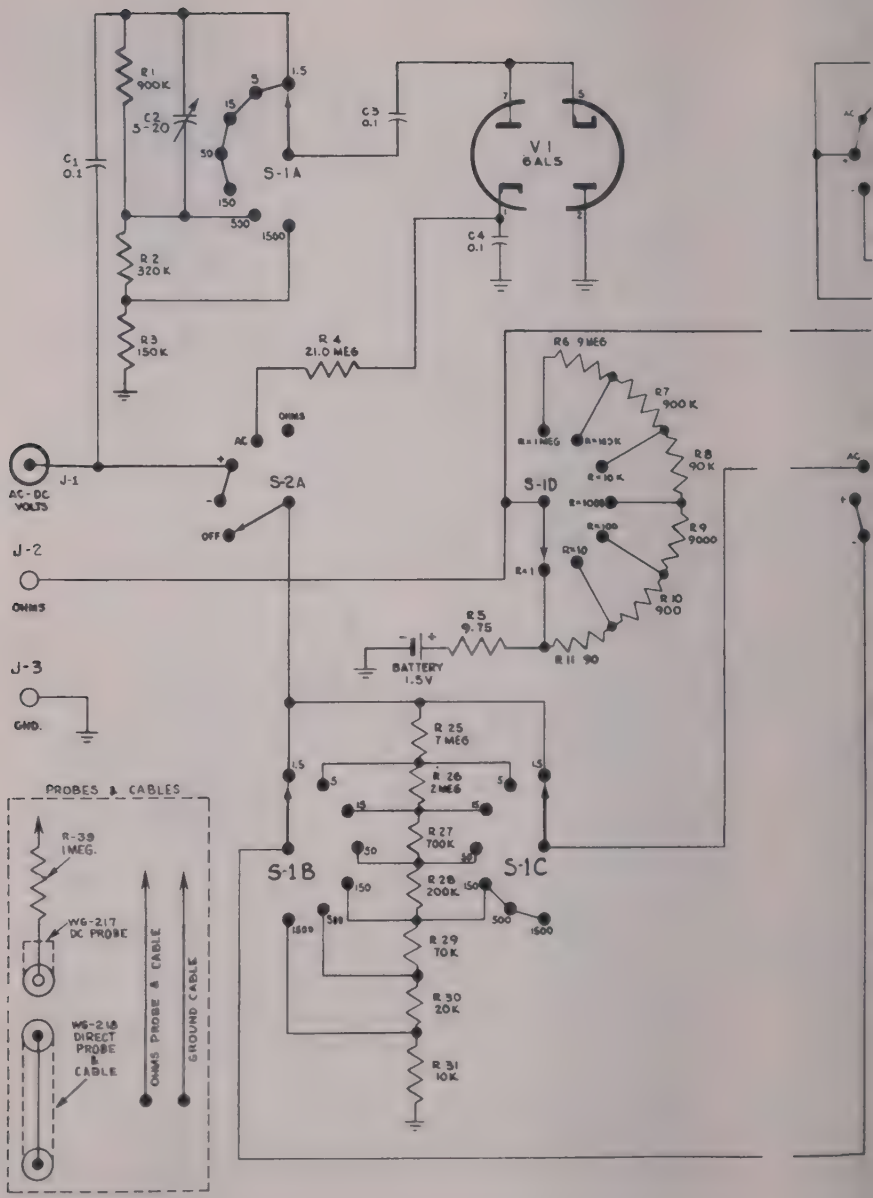
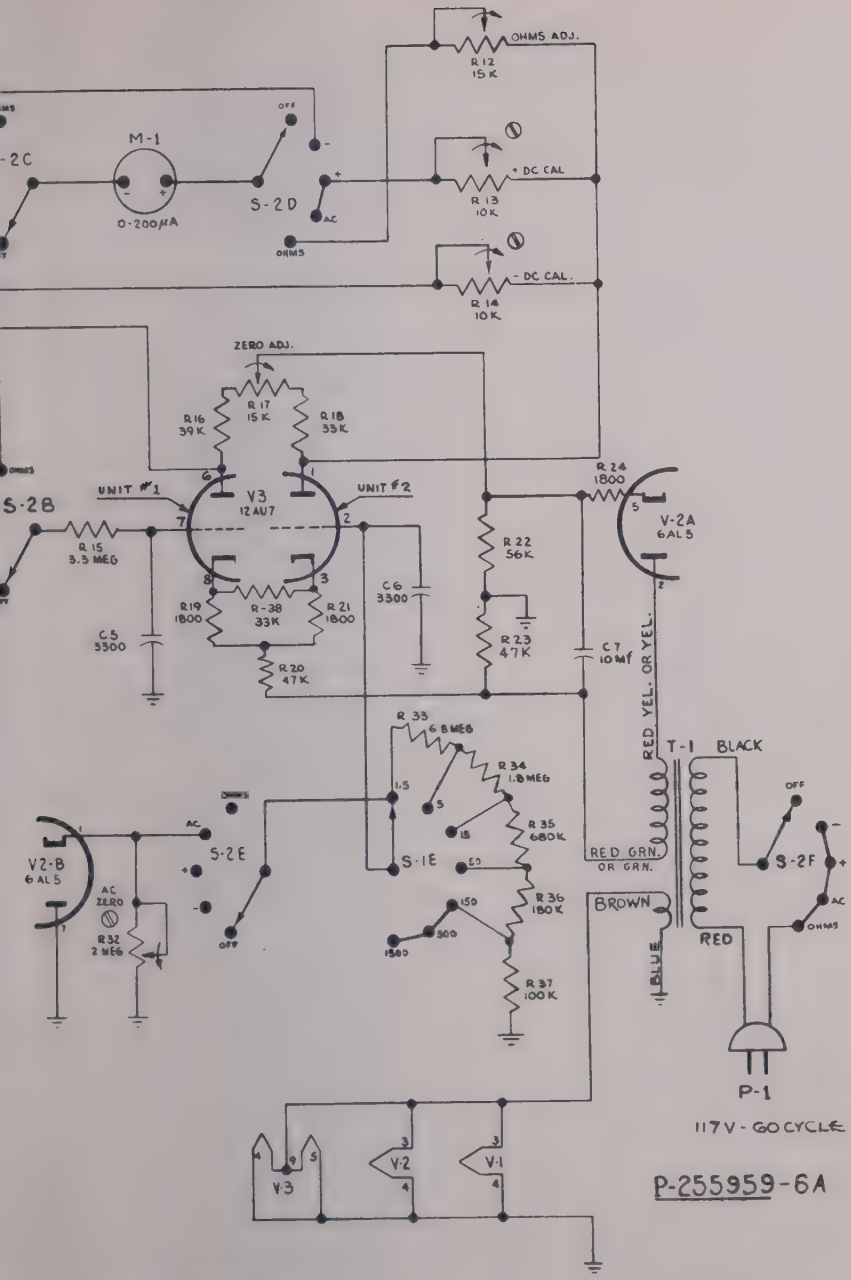


Figure 10. Schematic diagram for



instruments with code no. 350

Replacement Parts List

WV-97A Senior VoltOhmyst

When ordering replacement parts, include serial number and code number of instrument. Parts should be ordered through a local RCA tube and parts distributor.

Symbol No.	Description	Stock No.
	Capacitors	
C 1*	Paper, tubular: 0.047 μfd ±20%, 1000 volts	73597
C 1◆	Paper, tubular: 0.1 μfd ±20%, 600 volts	73557
C 2*	Trimmer, ceramic: 5-20 μμf ±20%	64689
C 2◆	Trimmer, ceramic: 1.5-7 μμf ±20%	56690
C 3* C 4*	Paper, molded: 0.1 μf ±20%, 400 volts	73551
C 3◆ C 4◆	Paper, molded: 0.047 μf ±20%, 400 volts	73553
C 5 C 6	Mica: 3300 μμf ±20%, 600 volts	39664
C 7*	Electrolytic, dry: 10 μf ±20%, 150 volts	56234
C 7◆	Electrolytic, dry: 10 μf −10% +100%, 250 volts	93869
	Jacks and Connectors	
J 1	Connector, cable: chassis mounting type	96257
J 2*	Jack: for 0.125″ pin	55239
J 2◆	Jack: for 0.08″ pin	93858
J 3*	Jack: for 0.125″ pin	55239
J 3◆	Jack: for 0.08″ pin	93858
	Resistors	
R 1	Carbon film: 0.9 meg ±1%, 1 watt	59536
R 2*	Carbon film: 320,000 ohms ±1%, ½ watt	59544
R 2◆	Carbon film: 325,000 ohms ±1%, ½ watt	93872
R 3	Carbon film: 150,000 ohms ±1%, ½ watt	56483
R 4■	Carbon film: 21 meg ±1%, 1 watt	59537
R 4◆	Carbon film: 20.3 meg ±1%, 1 watt	93871
R 5	Wire wound: 9.75 ohms ±1%, 1 watt	96613
R 6	Carbon film: 9 meg ±1%, 1 watt	59539
R 7	Carbon film: 0.9 meg ±1%, ½ watt	55661
R 8	Carbon film: 90,000 ohms ±1%, ½ watt	56725
R 9	Carbon film: 9000 ohms ±1%, ½ watt	56723
R 10	Carbon film: 900 ohms ±1%, ½ watt	54197
R 11	Carbon film: 90 ohms ±1%, ½ watt	96614
R 12	Variable, carbon: 15,000 ohms ±20%, ½ watt	59532
R 13 R 14	Variable, carbon: 10,000 ohms ±20%, ¼ watt	59533
R 15	Composition: 3.3 meg ±10%, ½ watt	31417

Symbol No.	Description	Stock No.
R 16§	Composition: 39,000 ohms ±5%, ½ watt	30147
R 16▲	Composition: 36,000 ohms ±5%, ½ watt	502336
R 17§	Variable, carbon, 15,000 ohms ±20%, ½ watt	59532
R 17▲	Variable, carbon, 20,000 ohms ±20%, ½ watt	97844
R 18	Composition: 33,000 ohms ±5%, ½ watt	502333§
R 18	Composition: 30,000 ohms ±5%, ½ watt	502330▲
R 19	Composition: 1800 ohms ±5%, ½ watt	502218
R 20	Composition: 47,000 ohms ±5%, ½ watt	30787
R 21	Same as R 19	——
R 22	Composition: 56,000 ohms ±5%, ½ watt	502356
R 23	Same as R 20	——
R 24	Same as R 19	——
R 25	Carbon film: 7 meg ±1%, 1 watt	59538
R 26	Carbon film: 2 meg ±1%, ½ watt	59540
R 27	Carbon film: 0.7 meg ±1%, ½ watt	59541
R 28	Carbon film: 0.2 meg ±1%, ½ watt	56733
R 29	Carbon film: 70,000 ohms ±1%, ½ watt	59542
R 30	Carbon film: 20,000 ohms ±1%, ½ watt	59177
R 31	Carbon film: 10,000 ohms ±1%, ½ watt	55665
R 32	Variable, carbon, 2 meg ±20%, ½ watt	59534
R 33	Composition: 6.8 meg ±5%, ½ watt	31071
R 34	Composition: 1.8 meg ±5%, ½ watt	11769
R 35	Composition: 680,000 ohms ±5%, ½ watt	30562
R 36	Composition: 180,000 ohms ±5%, ½ watt	502418
R 37	Composition: 0.1 meg ±5%, ½ watt	502410
R 38§	Composition: 33,000 ohms ±5%, ½ watt	502333
R 38▲	Composition: 22,000 ohms ±10%, ½ watt	502322
R 40††	Composition: 1500 ohms ±10%, ½ watt	502215
	Switches	
S 1*	Rotary: "Range" (includes S1A, S1B, S1C, S1D, S1E) 7 positions, 3 sections, 5 circuits	59525
S 1†	Rotary: "Range" (includes S1A, S1B, S1C, S1D, S1E) 7 positions, 3 sections, 5 circuits	93868

Symbol No.	Description	Stock No.
S 2*	Rotary: "Function" (includes S2A, S2B, S2C, S2D, S2E, S2F) 5 positions, 2 sections, 4 circuits	59526
S 2†	Rotary: "Selector" (includes S2A, S2B, S2C, S2D, S2E, S2F, S2G) 5 positions, 3 sections, 7 circuits	93867
	* * * * * * * * *	
M 1	Meter: 0-200 μamp	59523
T 1	Transformer, power: 117 volts, 60 cps	59527
	Cable, ground: black, with alligator clip and phone tip	48996●
	Cable, ground: black, with alligator clip and phone tip	93832◆
	Cable, ohms: with probe and phone tip	51960●
	Cable, ohms: with probe and phone tip	93859◆
	Case, meter: plastic, black	93811
	Case, meter: plastic, blue	93812
	Case, instrument: steel, less front panel	59546
	Clamp, battery: with U-shaped bracket	59524
	Clip, alligator: for ground cable	35262
	Clip, alligator, "slip-on" type	59410
	Cord, power: 72″ long, with plug	70392
	Handle, carrying: leather	44091
	Insulator: for clip	99539
	Knob, control: large	59543
	Knob, control: small	53689
	Pin plug: black, 0.125″ pin, for ohms and ground cables	47089‡●
	Pin plug: black, 0.08″ pin, for ground cable	93856◆

Symbol No.	Description	Stock No.
	Pin plug: red, 0.08″ pin, for ohms cable	93857◆
	Socket, tube: miniature, 7 pins	94925◆
	Socket, tube: miniature, 9 pins	59531
	WG-218 Direct Probe and Cable	
	Cable, coaxial: 38″ long	RG62U
	Connector: threaded, microphone type	48982
	Connector: with tip, for front end of probe	96318
	Shell: polystyrene, black	59529
	Sleeve: polystyrene, threaded	59530
	WG-222 DC/Direct Probe▲	
	Bushing	97212
	Connector	97206
	Insert	59548
	Nut: hex head, #12-24	97211
R 501	Resistor: composition, 1 meg ±5%, ½ watt	502510
	Screw: flat head, 4-40, 5/32″ long	——
	Shell	97207
	Shield: copper	59550
	Switch: slide type	97210
	Spring	97209
	Tip	97208
	WG-217 DC Probe§	
	Connector: female	59547
	Insert	59548
	Nut: hex head, #12-24	97211
R 501	Resistor: composition, 1 meg ±5%, ½ watt	502510
	Screw: flat head, 4-40, 5/32″ long	——
	Shell: polystyrene, black	59549
	Shield: copper	59550
	Tip	59551

* For instruments with code no. 350.

† For all instruments except those with code no. 350.

● For instruments with code nos. 350 and 850.

◆ For all instruments except those with code nos. 350 and 850.

■ For all instruments except those with code nos. 850, 1150, 251, 851, and 252.

◆ For instruments with code nos. 850, 1150, 251, 851, and 252.

§ For instruments with code nos. 350, 850, 1150, 251, 851, and 252.

▲ For all instruments except those with code nos. 350, 850, 1150, 251, 851, and 252.

‡ For code nos. 350 and 850, red plug is not available. Order black plug, stock no. 47089.

††Used only on instruments having Code No. 854.

Circuit Description

The operation of the Senior VoltOhmyst centers around a vacuum-tube bridge circuit using a 12AU7 twin-triode. (See schematic diagrams, pages 18 and 19.) When this bridge is properly balanced, the voltages at the two plates will be equal and the 200-microampere meter, connected between the plates, will read zero.

When a positive voltage is applied to the grid of triode section 1, the current through the left half of the bridge is increased, causing the voltage at the plate of this section to decrease. This current also flows through the common cathode resistor, increasing the voltage drop across it, and biasing the grid of triode section 2 in a negative direction. This causes a voltage increase at the plate of triode section 2. The difference in potential across the meter causes current to flow through the meter from the plate of section 2 to the plate of section 1.

When the WV-97A is used to measure ac voltage, the voltage is first rectified by an RCA-6AL5 twin-diode which serves as a full-wave peak-to-peak rectifier. This tube, shown as V-1 on the schematic diagram, has associated components chosen to give the circuit a long time constant. When the ac signal swings negative, C-3 is charged through the left-hand diode section to the negative peak value of the voltage. As the voltage starts in a positive direction, this diode section becomes nonconducting and the charge on C-3 is prevented from discharging. As the ac signal swings positive, the positive peak is added in series with the charge on C-3 and is applied to the plate of the right-hand diode section. C-4 charged to a value equal to the sum of the positive and negative peaks. Because of the relatively long time constant of the circuit, the voltage across C-4 will be maintained at the peak-to-peak value of the applied ac voltage. This charge is then applied as a dc voltage to the grid of triode section 1 of the 12AU7 bridge tube and the circuit action is the same as described above.

When the ac-signal rectifier is connected, however, contact potential within the tube causes a small amount of voltage to appear at the left-hand grid of the 12AU7, resulting in a slight unbalance of the bridge and a small meter deflection. To counteract this effect, a diode section of another 6AL5 is connected to the other grid of the bridge tube. The bucking potential of this second diode section is used to correct for the contact potential of the ac-signal rectifier. This bucking potential may be adjusted to the exact required value by means of a potentiometer connected across the second diode section.

When the instrument is set up to measure resistance, ac voltage or dc voltage, it is impossible for any voltage applied to the test probes to be applied directly to the meter itself. As shown in the schematic diagram, the meter is isolated from the source voltage by the 12AU7 bridge tube. This current limitation of the 12AU7 and its associated components decreases the danger of overloading the meter.

Maintenance

(See "Safety Precautions", page 2)

The WV-97A Senior VoltOhmyst is manufactured, tested, and calibrated under strict engineering supervision. If the instrument should require adjustment or repairs, the procedures outlined below should be followed.

Schematic diagrams of the WV-97A are shown in Figure 9 and 10. Locations of calibration controls are shown in Figure 11. If it becomes necessary to replace any of the component parts, only RCA replacement parts or their equivalents should be used. Replacement parts should be ordered from a local RCA tube and parts distributor and the code and serial numbers of the instrument, as well as the stock number of the replacement parts, should be specified when ordering. Stock numbers and descriptions should be obtained from the Replacement Parts List on pages 22 and 23.

Zero Setting of Pointer

Mechanical Adjustment:

The meter pointer should rest at the left-hand zero mark when the function selector is turned to the "OFF" position. If the pointer should come to rest at a deflected position, the position may be corrected mechanically as follows:

1. Unscrew the moisture-proof meter-adjustment screw plug.
2. Insert a scriber or similar tool to engage the zero-adjustment lever, and move the lever laterally as required to bring the pointer to "0".

CAUTION: Extreme care must be taken to prevent insertion of the tool to a depth which will injure the pointer spring. The meter warranty does not cover such damage.

3. Replace the meter-adjustment screw plug.

Meter Response:

For those instruments with code No. 350, a time delay will be observed after ac measurements are made. This will ensue from the instant that the leads are removed from the voltage source being measured to the instant the meter pointer returns to "0". This delay is normal and is caused by circuit constants so chosen that recurrent pulses with low repetition rates may be accurately measured. In applications where it is desirable to measure recurrent pulses with relatively high repetition rates, the time required for the meter needle to return to "0" may be decreased by reducing the value of capacitors C-3 and C-4 from 0.1 μf to 0.047 μf.

Anti-Static Solution:

The inside of the plastic meter case has been coated with a special anti-static solution to eliminate static effects on the action of the pointer. If the meter-pointer action becomes erratic, the condition of the coating may be checked by vigorously wiping the outside of the meter window with a clean, soft, dry cloth. If the anti-static coating has lost its effectiveness, the meter pointer will move off zero and remain there for several minutes. VoltOhmyst owners whose registration cards are on file at the RCA Camden, N. J. office may obtain a free 1-ounce bottle of coating by writing to RCA, Order Service, Building 60, Camden, N. J.

Electrical Balance Check:

1. Set the function selector to "+VOLTS" and allow the WV-97A to warm up for 15 minutes.

2. Rotate the ZERO ADJ control. It should be possible to set the meter pointer at either zero or 60% of full-scale deflection on any range.

3. Set the SELECTOR control to "—VOLTS".

4. Rotate the ZERO ADJ control. It should be possible to set the meter pointer at either zero or 10% of full-scale deflection on any range.

5. If the conditions given in steps 2 and 4 above cannot be satisfied, there is an unbalance between the two triode sections of the 12AU7 bridge tube and it should be replaced. See the section on Tube Replacement below.

Calibration

The calibration of the WV-97A should be checked after any internal adjustments are made or after any of the component parts are replaced. If recalibration is necessary, the instrument should first be recalibrated on dc voltage as follows:

NOTE: The accuracy of calibration cannot exceed the accuracy of the standards employed.

DC-Voltage Calibration:

1. Check the mechanical zero position of the pointer. If necessary, zero the pointer as described above.

2. Turn the function selector to "+VOLTS" and allow the WV-97A to warm up for at least 30 minutes.

3. Check the line voltage. The WV-97A should be calibrated at 117 volts, 60 cycles.

4. Rotate the ZERO ADJ control to bring the pointer exactly to zero. This control should not be readjusted during the rest of the calibrating procedure.

5. Set the range control at "50V".

6. Connect the Ground Cable clip to the negative terminal of a dc voltage source supplying exactly 50 volts. The switch on the DC/Direct Probe should be set to "DC". Connect the DC/Direct Probe to the positive terminal of the source voltage.

7. With a screw driver, adjust the "+DC CAL" potentiometer R13 to bring the pointer exactly to the 50-volt mark on the scale. (See Figure 11 for location of calibration controls.)

8. Reverse the test lead connections at the voltage source.

9. Set the function selector to "—VOLTS".

10. With a screw driver, adjust the "—DC CAL" potentiometer R14 to bring the pointer exactly to the 50-volt mark on the scale.

11. Check the remaining dc-voltage ranges against other dc sources of known accuracy which provide full-scale deflection.

AC-Voltage Calibration:

Before calibrating the WV-97A for ac voltage, the instrument should first be calibrated for dc voltage. To calibrate for ac voltage, proceed as follows:

1. Set the switch on the DC/Direct Probe to "Direct".

2. Set the function selector to "AC VOLTS".

3. Set the range selector to "1.5 VOLTS".

4. Short the DC/Direct Probe to the ground clip and adjust the AC ZERO

potentiometer so that the pointer rests exactly at zero. If a zero meter reading cannot be obtained, interchange the two 6AL5 tubes. If the pointer cannot be brought to zero after interchanging the tubes, they should be replaced. See "Tube Replacement", below.

5. Set the range control to "50V".

6. Apply 50 volts, 60 cps between the ground lead and the tip of the DC/Direct Probe. The meter reading should be within ±5%. If the accuracy is not within this figure, values of circuit components should be checked.

AC-Compensation Adjustment:

1. Set the switch on the DC/Direct Probe to "Direct".
2. Set the function selector to "AC VOLTS".
3. Set meter pointer at zero.
4. Set the range selector at the 150-volt range and apply an ac signal of approximately 150 volts at 100 Kc to the test leads. *Adjust the voltage source* for a reading on the VoltOhmyst of exactly full scale.
5. Set the range selector at the 500-volt range. With the 150-volt 100 Kc signal applied, adjust C2 with a screw driver for a reading of exactly 150 volts (see Figure 11 for locations of calibration controls).

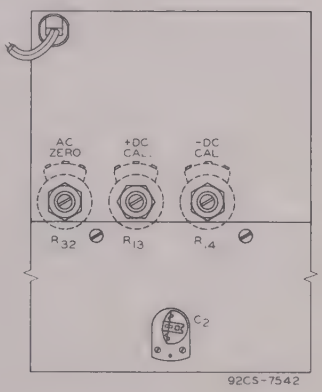


Figure 11. Locations of calibration controls

Ohms Adjustment

NOTE: The battery must be installed for all resistance measurements.

1. Set the function selector to "+VOLTS" and make certain the pointer is at zero.
2. Turn the function selector to the "OHMS" position.
3. Set the range control to "RX1".
4. Adjust the OHMS ADJ control for full-scale deflection.
5. Turn the range switch to the "RX1MEG" position. The meter pointer should read above 1000 on the resistance scale. If the pointer indicates a lower value, there is excessive leakage in the ohmmeter circuit.

If it is necessary to readjust the OHMS ADJ control when changing from a low-range position to the "RX1MEG" position, refer to the section on Tube

Replacement below. If it is impossible to obtain full-scale setting of the pointer with the OHMS ADJ control and correct ac and dc voltage readings can be obtained, the battery should be replaced.

Tube Replacement

All tubes supplied originally with WV-97A have been thoroughly aged by operating them for several hours before installation in the instrument. This preliminary conditioning of a new tube helps to insure stability and dependable performance.

If a new tube is installed without prior aging, it may be necessary to rezero the instrument when it is switched from the lowest to the highest dc-voltage range. This operating inconvenience may be corrected by aging the tube as follows.

Before installing a 12AU7, age the tube by connecting the grids and cathodes to one side of a 117-volt, 60-cycle line and the two plates to the other side of the line. The heaters should be operated at normal voltage. The tube should be operated in this manner for a minimum of 12 hours before it is installed in the instrument. The calibration should then be checked.

An alternate, and usually satisfactory, aging procedure consists of operating the new tube in the WV-97A for approximately 36 hours, after which time the instrument may be recalibrated. If this procedure is unsatisfactory, the first aging procedure should be followed.

If it becomes necessary to replace a 6AL5, the tube can be aged for a minimum period of 36 hours by operating it in the instrument. After this period of time, the calibration should be checked according to the procedure outlined under "AC Calibration Check".

Battery Testing

CAUTION: Do not allow exhausted cells to remain inside the case of the WV-97A as chemicals from deteriorated cells may damage the instrument.

The battery should be tested frequently to insure accuracy of resistance measurements. It may be tested as follows.

1. Turn function selector to "OHMS".
2. Set range control to "RX1" position.
3. Rotate the OHMS ADJ control to bring the pointer to full scale deflection.
4. Short the Ohms Cable to the Ground Cable for about 10 seconds.
5. Open the short circuit and observe the scale indication. Any appreciable deviation from full-scale deflection indicates weak cells which should be replaced.

Trouble-Shooting the WV-97A

The trouble-shooting data given below are designed to aid the technician in servicing the WV-97A. The troubles described are those which have the most obvious symptoms. Because it is impossible to list all possible troubles, the technician should use the information in conjunction with the correct schematic diagram to trace down unlisted troubles.

If difficulty is experienced, it is important that the instrument be checked on *all ranges and all functions* before repairs are attempted. Examination of the schematic diagram will show that the voltage divider network used for resistance measurements is not used when the instrument is switched for voltage measurements. Similar differences in other circuits also will be evident. For example, V1, the ac-signal rectifier, and its associated circuitry are used only when the WV-97A is switched to "AC VOLTS" and is out of operation on ohms and dc-voltage measurements. Also, the resistor network around S1B and S1C is employed only on ac and dc voltage measurements. A complete performance check can thus aid greatly in isolating the trouble to one or two sections of the instrument.

Because there are different models of the VoltOhmyst which differ in circuit design, the code number on the instrument should be checked against the code number of the schematic diagram.

When trouble is encountered, a visual check of wiring should be made first. All wiring and solder joints should be inspected closely. Shorted leads or burned components may indicate quickly where the trouble is. The causes and possible remedies listed are given in probable order of occurrence. The description of the trouble should be located in the bold-face type and possible causes checked in the order listed.

When soldering to or near the switches, care should be taken to prevent overheating or mechanically scraping the precision resistors in the divider networks. Excessive heating may permanently change the value of the resistors and result in inaccurate meter readings. A pair of long-nose pliers may be clamped to the lead between the resistor being soldered and the point of connection to dissipate as much heat as possible. Care should also be taken to prevent twisting or loosening of the switch contacts and to prevent solder from getting down into the switch. Contacts may be cleaned with cigarette-lighter fluid.

General

Instrument fails to operate on all functions; tubes do not light.

1. Line cord broken or not making contact at outlet.
2. Switch section S2F defective.
3. T1 defective. Check continuity of windings and resistance to ground.

Instrument fails to operate on all functions; tubes light, ZERO ADJ does not work.

1. Broken lead in ground cable or J3 defective.
2. Incorrect operating voltages on bridge tube. Measure voltages with voltmeter.
3. V2 or V3 defective. Replace as described under section "Tube Replacement."
4. Open or short circuit in V3 bridge circuit. Check out with ohmmeter. Check R24, C7, T1 secondary, and meter leads.
5. Switch section S2B, S2C, or S2D defective.

Meter pointer sticks.

1. Cracked or broken jewel bearing in meter. NOTE: Individual replacement parts for meter movement are not available. Meter should be returned for repairs or replaced with new meter.

2. Scale plate or meter is loose and is striking pointer. Remove meter from meter case and tighten mounting screws.

Meter pointer moves sluggishly; slow return to zero point.

1. Anti-static solution on inside of plastic meter window is no longer effective. Recoat with solution. See section on "Anti-Static Solution."
2. Anti-static coating is not grounded. Tighten up the three nuts on back of meter-mounting screws.
3. Slow zero return normal on some instruments. See section on "Meter Response."

Meter pointer bangs hard left or right, depending upon setting of function switch.

1. Open or short circuit in bridge circuit.

Intermittent operation on all functions.

1. Loose or broken connections in cables. Check by flexing cables and observing meter readings.
2. Poor ground connection between ground jack and ground bus of chassis. Check lead or replace by installing lead directly from jack to ground bus.
3. Wiper contact on S2B, S2C, or S2D defective.
4. Loose or broken connection in bridge circuit wiring, including meter terminals. With power applied, probe wiring, connections, and components with insulated probe. CAUTION: See "Safety Precautions," page 2.
5. V2 or V3 defective. Replace tubes as described under "Tube Replacement."

ZERO ADJ control erratic in operation.

1. Potentiometer R17 defective. Replace with new control. NOTE: First, make sure mechanical zero of meter pointer is correct. See "Zero Setting of Pointer."

Ohms Function

Instrument fails to indicate on OHMS; works normally on ac and dc voltage measurements.

1. Battery exhausted or not making contact.
2. Loose or broken connection in ohms cable. Check by flexing cable and observing meter reading.
3. Defective wiper contact on switch section S1D.

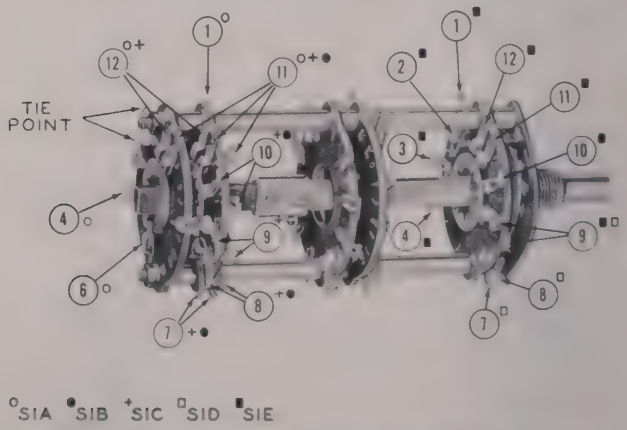


Figure 12. Locations of contacts on range switch, S1

4. "Ohms" contact (terminal 3) on S2B defective.
5. Open circuit in resistor network or burned-out resistor around switch section S1D. Check continuity of network R5 through R11. NOTE: This network is made up of resistors which are added in series as switch is rotated. Therefore, one faulty resistor may cause improper operation on one or more ranges.
6. OHMS jack, J2, or its attaching lead open or shorted to other wiring or to instrument case. Check resistance to case and adjacent wiring.
7. Loose or broken "Ohms" contact on switch section S2C or S2D.
8. Cable connector not making contact.

OHMS ADJ fails to give infinity setting on "R" scale.

1. Battery exhausted.
2. OHMS ADJ potentiometer, R12, defective.
3. V3 defective.

Resistance readings inaccurate on some or all "ohms" ranges.

1. One or more resistors in network around switch section S1D have changed value.
2. Excessive leakage in "ohms" circuit. Check switch wafers on S1D and S2B for dirt or damage. NOTE: High humidity may cause leakage and inaccurate readings on high ohms scales. Bake out inside of instrument with light bulb. Do not overheat and damage plastic meter case or wax-impregnated capacitors.
3. Poor contact from ground jack to ground bus on chassis.
4. Shorted wiring in resistor network around S1D.
5. Faulty or high-resistance connections in "ohms" circuit.

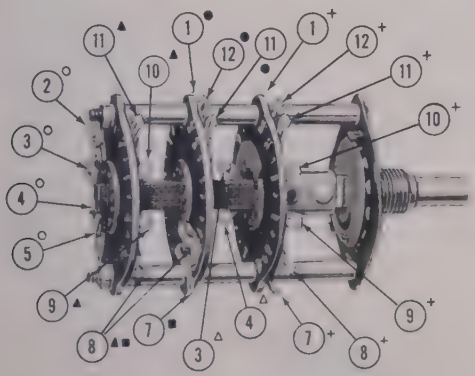
Meter pointer moves off infinity mark when range switch is changed.

1. Replace V3 with 12AU7 having low value of gas current. See "Tube Replacement." NOTE: (A small deviation should be considered acceptable.)
2. Excessive leakage in ohms circuit, possibly caused by high humidity. Check by baking out for several hours with light bulb. Do not overheat and damage plastic meter case or wax-impregnated capacitors.

AC-Voltage Function

Instrument fails to indicate on any ac-voltage range; works normally on OHMS and DC VOLTS.

1. V1 defective. See "Tube Replacement."



°S2A •S2B +S2C +S2D ■S2E △S2F ▲S2G

Figure 13. Locations of contacts on function switch, S2

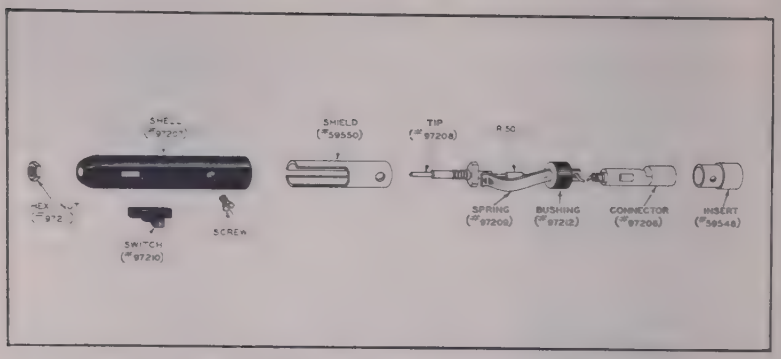


Figure 14. Exploded view of WG-222 DC/Direct Probe

2. AC volts contact on S2A, S2B, S2C, or S2D may be defective.
3. Faulty wiper contact on S1A.
4. Open or short circuit in circuitry associated with V1. Check out wiring and components values with ohmmeter.
5. C1 or C3 open, C4 shorted, or R4 open.

Meter pointer moves off zero when ranges are changed.

1. "AC Zero" potentiometer out of adjustment. Readjust as described under "AC Calibration Check." If adjustment cannot be made, then
2. Interchange V1 and V2 or replace one or both tubes. See "Tube Replacement."
3. Resistor network around S1E is defective. Check continuity and values with ohmmeter.

AC-voltage readings inaccurate on all ac ranges; performance on ohms and dc-voltage ranges is normal.

1. V1 defective. Install new 6AL5. See "Tube Replacement."
2. C4 leaky.
3. R4 changed in value.

If instrument is inaccurate on 500 and 1500 volt ranges only, check R1, R2, R3, and C2. If inaccurate on 1.5-volt range only, replace V1. See "Tube Replacement."

AC and dc-voltage readings inaccurate on some or all ranges; resistance readings correct.

1. Resistor network around switch S1B and S1C defective. Check values with ohmmeter.
2. Defective contacts or wipers on S1B or S1C. Check for loose or dirty contacts.
3. Excessive leakage in switch section S1B or S1C. Check for dirt or foreign material.

Figure 15. Exploded view of WG-217 DC Probe

DC-Voltage Function

Instrument fails to indicate on any range of "+VOLTS" or "—VOLTS"; works normally on ohms and ac volts.

1. DC slip-on probe is defective. Try applying low dc voltage directly to WG-218 Direct Probe tip.
2. DC-voltage contacts on switch sections S2A, S2B, S2C, or S2D are defective. Check for loose or broken contacts.

Instrument fails to indicate on any range of "+VOLTS" but normal on "—VOLTS" or vice versa; works normally on ohms and ac volts.

1. Potentiometer R14 defective. Check out with ohmmeter.
2. Defective contacts on switch sections S2A, S2B, S2C, or S2D. Check switches for loose or broken contacts.

Voltage readings inaccurate on "+VOLTS", "—VOLTS", or both; ac voltage and resistance readings are correct.

1. R14 out of adjustment. Reset as described under "DC Voltage Calibration."
2. Isolating resistor in "slip-on" probe has changed value. Measure resistance on OHMS function. NOTE: If one or more of the low-value resistors in the network around S1C have changed value, it is possible that the meter reading may be inaccurate on the 500 and 1500 volt ranges but the inaccuracy may not be apparent on the lower ranges.

DC and AC voltage readings incorrect; resistance readings correct.

1. Resistance in network around S1B and S1C has changed value. Check out with ohmmeter and replace defective resistors.
2. Switch contacts on S1B, S1C, or S2A defective. Check for loose or broken contacts, or foreign material.

Instrument fails to function on ac and dc voltage measurements; works normally on ohms function.

1. Check Direct Probe and Cable and connector.
2. S1B and S1C network open.

RCA Repair Service

RCA maintains a complete repair service for the adjustment, calibration, and maintenance of RCA test equipment. If it becomes necessary to service this equipment, the report forms enclosed in this booklet should be filled out as described. It is important that:

1. Test equipment be packed carefully.
2. A full description of the trouble be included in the report.

Attention to these details will help prevent damage in transit and delay in repairs.

1037278

www.manualsplus.com